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REVISION OF THE SPIDER GENUS *NEOANAGRAPHIS* (ARANEAE, LIOCRANIDAE)

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ABSTRACT. The spider genus *Neoanagraphis* consists of two partially sympatric species, *N. chamberlini* Gertsch & Mulaik 1936 and *N. pearcei* Gertsch 1941. Herein I review the genus which is now transferred from the Clubionidae to the Liocranidae, provide a distribution map and describe the females for the first time. Over 55% of the specimens of both species examined in this study came from the Nevada Test Site (i.e., atomic bombing range) in southern Nevada. Collection phenology at this site showed almost non-overlapping temporal activity for the males and habitats for each species within this area. Immatures from the Nevada Test Site also could be separated where the ventral anterior tibia spination and habitat dichotomy matched that of the adults. If this extrapolation holds throughout the distribution and there are no additional species, one should be able to accurately identify immatures of any size to species.

Keywords: Arachnida, taxonomy

The spider genus *Neoanagraphis* was erected in 1936 with the naming of the type species, *N. chamberlini,* based upon one mature male which was initially assigned to the family Gnaphosidae (Gertsch & Mulaik 1936). A second species, *N. pearcei,* was later described, again from a single male specimen and the genus was transferred to the family Clubionidae (Gertsch 1941). From this point, *Neoanagraphis* is scarcely mentioned in the literature except in faunal surveys (Allred et al. 1963a; Allred & Gertsch 1976; Allred & Kaston 1983; Jung & Roth 1974; Ryckman & Lee 1956).

Neoanagraphis is a rather non-descript looking "clubionoid" spider with the exception of the unique characteristic that the tarsal claws of legs III and IV are extremely long with few teeth at the base (Fig. 1). Here I review this genus of spiders and describe the females of both species for the first time.

The acronyms used in this paper are as follows: AMNH = American Museum of Natural History, N. Platnick; CAS = California Academy of Science, C. Griswold, D. Ubick; CDFA = California Department Food & Agriculture, Visalia, California, M. Moody; JLO = J.L. Ortiz, Laguna Niguel, California; NMSU = New Mexico State University Arthropod Museum, D. Richman; UCR = Entomology Museum, University California-Riverside; VDR = V.D. Roth, Portal, Arizona; WRI = W.R. Icenogle, Winchester, California.

METHODS

All specimens were examined under alcohol with a Wild M5 Microscope with ocular micrometer. Leg measurements and spination pattern were taken from 20 spiders of each gender of each species where possible; spiders used here had at least four legs from the same side of the body intact. (Many specimens were collected in pitfall traps and, hence, were desiccated with multiple disarticulated limbs). Explanation of spination pattern: 1-1-1 represents surface having 1 basal and 1 distal spine with 1 median spine equidistant between them, 1-1-0-2 represents surface with 1 basal and 2 distal spines with 1 median spine about twice as far from distal as the basal. Where possible, up to half of each cohort of 20 originated from the Nevada Test Site (NTS). All mature spiders examined in this study were measured for cephalothorax and abdomen widths and lengths as well as cymbium length or epigynal plate width and length. Epigynal plate width was measured as the distance between the median aspects of the base of the lateral spurs; epigynal plate length was measured from the epigynal plate width line to the posterior tip of the plate. All measurements in the paper are presented in millimeters and the limits of the range are presented in parenthe-

Figure 1.—Leg IV tarsus of *Neoanagraphis* showing the long, nearly unarmed claw.

ses. Additional methods are described under sections where pertinent. Elevation data not recorded on the specimen label were obtained in correspondence with either the original collector or with arachnologists familiar with the collection locale.

Live-captured mature specimens (2♂, 1♀) were boiled in water for 5 min to splay the spinnerets. They were preserved in 70% alcohol and sent to the AMNH for examination to determine whether the genus would remain in the Clubionidae.

KEY

1. Anterior tibia with two pairs of ventral spines (apicals weak if present); tip of embolus short, blunt, appearing often as folded flap (Figs. 2, 3); posteriorly-directed epigynal plate usually as long as wide or longer, usually V-shaped and usually extending to the posterior edge of the spermathecae or beyond (Fig. 4, 5) . . *chamberlini*
2. Anterior tibia with three pairs of ventral spines (apicals weak if present); tip of embolus long, thin, scythe-like (Figs. 6, 7); posteriorly-directed epigynal plate usually wider than long, U-shaped and extending at most to the midpoint of the spermathecae (Fig. 8) . . . . . *pearcei*

TAXONOMY

Neoanagraphis Gertsch & Mulaik 1936
Figures 1, 10

Neoanagraphis Gertsch & Mulaik 1936: 11 (Gnaphosidae); Gertsch 1941: 19 (Clubionidae); Comstock 1948: 327 (Gnaphosidae); Roewer 1955: 559 (Clubionidae, Liocraninae, Liocraneae); Bonnet 1958: 3046 (Drassidae); Lehtinen 1967: 251 (Clubionidae *sensu* str.); Brignoli 1983: 549 (Clubionidae, Clubioninae); Platnick 1993: 605 (Clubionidae); Platnick 1998: 701 (Clubionidae)

Type species.—*Neoanagraphis chamberlini* Gertsch & Mulaik 1936 by original designation.

Diagnosis.—Whether one considers *Neoanagraphis* spiders in the broad sense of all the genera formerly housed in the Clubionidae or in the Liocranidae, they can be distinguished from other North American genera in either family by the long tarsal claws on legs III and IV that appear almost devoid of teeth.

Description.—Small to medium-sized spiders, with no bodily pigmentation. Coloration of few live specimens examined similar to those preserved in alcohol: cephalothorax uniformly pale orange to tan-orange, darkening anteriorly, width about ⅔ of length, widest at legs II-III, males slightly wider than females, covered with thin, white hairs with scattered, dark, anteriorly or medially directed setae. Longitudinal row of single, anteriorly-directed setae between eyes and thoracic furrow. Eyes subequal surrounded by black rings. AER recurved in dorsal view, slightly procurved in anterior view, eyes separated by less than eye diameter. AME dull but not black, all others luminescent. PER straight to slightly recurved in dorsal view, procurved in anterior view, PLE separated from PME by eye diameter, PME slightly farther from each other. PER slightly longer than AER with PLE extended laterally just beyond ALE. Clypeus about height of eye diameter. Undivided chilum. Conspicuous longitudinal thoracic furrow. Chelicerae dusky orange, darker than cephalothorax. Teeth: 3 promargin, 2 retromargin, latter separated by 3× width of tooth base. Conspicuous boss. Endites quadrate, labium slightly wider than long. Sternum slightly longer than wide, sometimes darker than legs. Coxa similar in color to legs. Pre-coxal triangles lacking. Trochanters notched, III and IV deeply so. Legs similar in color to cephalothorax with heavy spination. Leg IV longest, about 15–40% longer than legs I-III which are all subequal in length with minute plumose or feathery hairs. Tarsi lacking claw tufts, dense with white scopulae, sometimes appearing flexible in preserved specimens. Tarsal claws of posterior legs extremely long with few teeth at base, almost hidden (Fig. 1). Tarsal claws of anterior legs shorter, looking more typical. Trichobothria on tarsi and metatarsi of varying lengths, some very long. Spination

pattern virtually non-varying for dorsal femora and ventral metatarsi; retrolateral surfaces show greatest variation (patterns that differ between genders/species listed separately under species descriptions). Some spines rest intermediate between two surfaces; these were consistently assigned to one surface although they readily could have been assigned to another. Patterns that were most consistent between both sexes and both species are: femora: I, II p0-1-1 or 0-1-1-1; I–IV d1-1-1; tibiae: III p1-1-1, d1-0-1, v2-2-2, IV p1-1-1, d1-0-1, v2-2-2; metatarsi: I v2-2-0, II v2-2-0, III p1-1-0-2, r1-1-0-2, v2-2-2, IV p1-1-0-2, d1-1-0, r1-1-0-2, v2-2-2. Abdomen uniformly cream to tan, in rare instances brown, with scattered dark setae, no conspicuous markings, many long setae on anterior surface, oval in shape, width about ⅔ of length in well-preserved specimens. Occasionally heart can be seen through dorsal integument. In gross examination, ALS occasionally very long appearing gnaphosoid in character in preserved specimens otherwise appearing short and conical. Embolus of male palp dorsally projecting on apical-most portion of tegulum, membranous conductor dorsal to embolus. Median apophysis on retrolateral surface of tegulum above midline, translucent, elongate and concave. Epigynum with median plate, posteriorly-directed spines lateral where epigynal plate originates anteriorly. Anterior epigynal openings sometimes not readily visible. In dorsal view, epigynum with two simple oval spermathecae, each with duct arching anteriolaterally to small rotund structure (bursa copulatrix?).

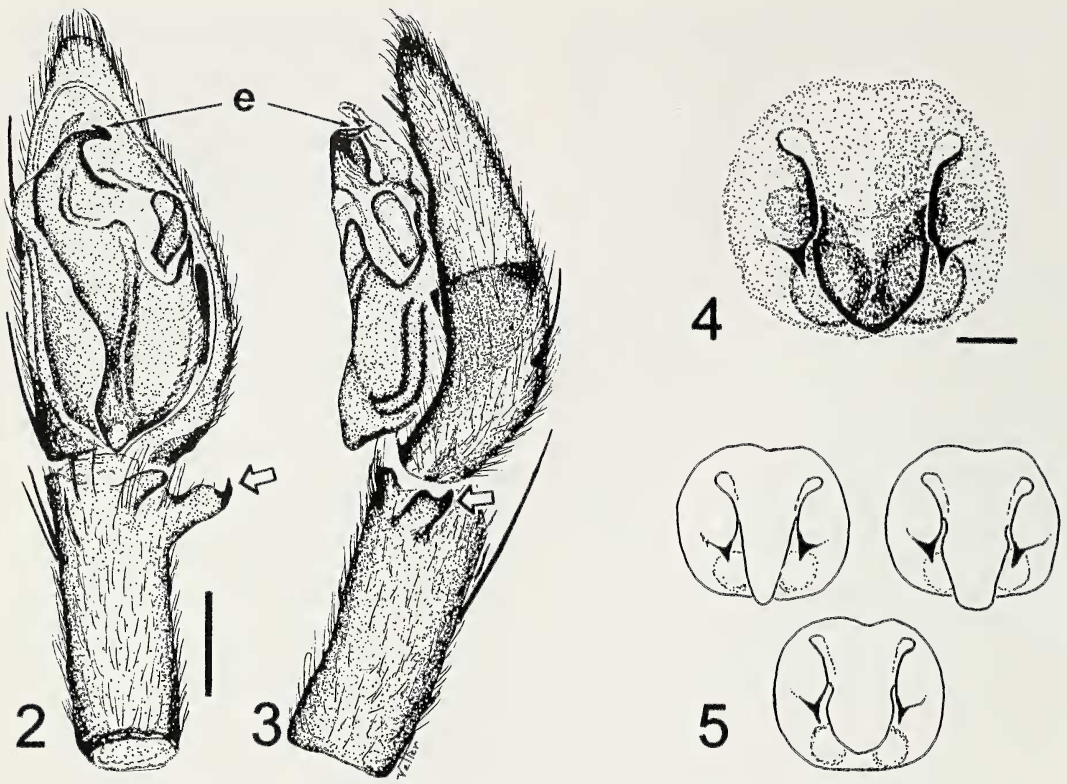
Natural history.—*Neoanagraphis* spiders have been collected in an unidentified mammal burrow (Ryckman & Lee 1956), in a tarantula (*Aphonopelma* sp.) burrow and in a kangaroo rat mound; but otherwise, little is known of their natural history. Several collection labels mention that the spiders were found on sand dunes or in washes; one male was live-collected as it crawled around a sandy wash around midnight, at 4 °C. They have been collected often at elevations of 900–1950 m; however, some were taken from below sea level near the Salton Sea to 200 m in Mexico and western Arizona. Jung and Roth (1974) listed it as being found in Zone 1 of their study which is characterized by limestone foothills, alluvial plains and valleys of the Chiracahua Mountains from 4000–5000 feet (1200–1500 m).

Only a few live specimens were captured during the course of this study. A female was maintained for >8 mon. She fed on *Drosophila* flies and small crickets but ignored mosquitoes, larval waxmoth (*Galleria mellonella*) and a spider (*Drassyllus insularis* Banks 1900).

Genitalic variation.—In this study, approximately 24 mature females of each species were available for examination. Despite fewer females relative to males, females showed greater genitalic variation. In both species, the epigyna are covered with hairs which obscure some of its minute features. The epigynal plate in *N. chamberlini* varied in length such that it could extend past the posterior edge of the underlying spermathecae or sometimes would just barely reach the posterior edge. Additionally, although the plate was usually V-shaped, the width of the plate varied from narrow to wide, and sometimes was rounded on the posterior edge (Fig. 5) similar to *N. pearcei.* The plate in *N. pearcei* was comparatively less variable in length, width and its rounded, U-shaped posterior edge (Fig. 8), however, at least one specimen had a V-shaped plate reminiscent of *N. chamberlini.* The lateral spurs were rather consistent in size within each species (conspicuous in *N. chamberlini,* minute in *N. pearcei*) and for the few specimens examined here that is a good diagnostic feature to be used in concert with other features such as anterior tibial spination. Yet they did vary from spike-like to that of an equilateral triangle and could be slightly different in form on the right and left sides of the same spider.

About half of the females of each species were dissected to inspect the dorsal view of the genitalia, leaving the other females intact for future researchers. There are no consistent internal characters that allow species separation. The small anterior rotund structures (bursa copulatrix?) for both species may lie directly on top of the spermathecae or extend laterally (Fig. 9). Likewise, the duct running to it may be thin or thick, and at an acute or obtuse angle of curvature. Possibly with greater numbers of spiders in the future, diagnostic internal features may become apparent.

In contrast, the males were very consistent in their palpal features with little marked var-



Figures 2–5.—*Neoanagraphis chamberlini* Gertsch & Mulaik. 2. Male left palp, ventral view; 3. Same, retrolateral view (scale = 0.25 mm); 4. Epigynum, ventral view, hairs removed from ventral surface (scale = 0.1 mm); 5. Schematic drawings of epigyna showing variation of epigynal plate and its position relative to the spermathecae. "e" = dorsally-directed embolus, additional arrows point to dorsal process of retrolateral tibial apophysis.

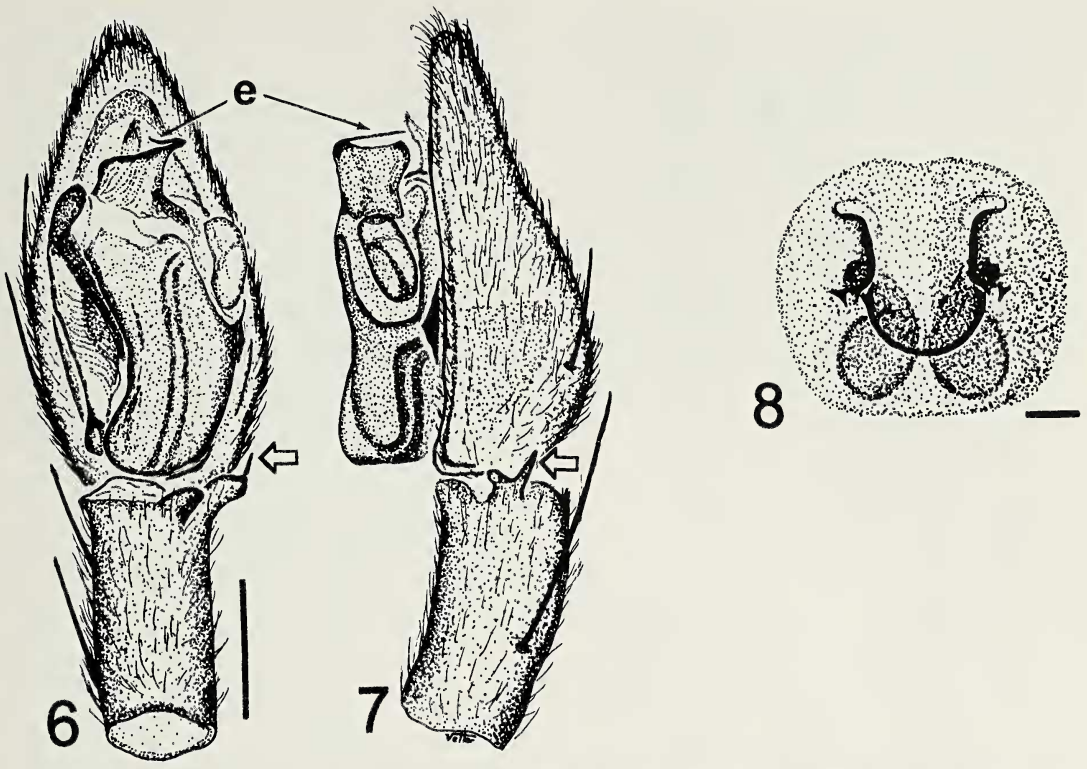
iation in characters except for differences due to aberrations caused by preservatives which expanded the palp or changed the relative orientation of the structures.

Neoanagraphis chamberlini Gertsch & Mulaik 1936
Figs. 2–5, 10

Neoanagraphis chamberlini Gertsch & Mulaik 1936: 11–12, fig. 15. Male holotype - White Sands, New Mexico, August 1934, in AMNH, examined.

Diagnosis.—The two species in the genus differ consistently in a number of traits and can be readily separated. *Neoanagraphis chamberlini* is characterized by (1) anterior tibia with two pairs of ventral spines (discounting smaller apicals if present), (2) the dorsal process of the retrolateral tibial apophysis (RTA) is thick and projected laterally (Fig. 2), (3) the dorsally-projecting embolus tip is truncate and looks like a folded flap or cresting wave (Fig. 3), and (4) the epigynal plate extends posteriorly past the midpoint, and most often to the posteriormost edge of the spermathecae (visible through the integument) or beyond (Fig. 4, 5). In contrast, *N. pearcei* has (1) anterior tibia with three pairs of ventral spines (discounting smaller apicals if present), (2) the RTA is forked with the dorsal process straight, thin and apically-directed (Fig. 7), (3) dorsally-projecting embolus is long, thin and scythe-like (Fig. 7), and (4) the epigynal plate extends posteriorly only to the middle of the spermathecae (Fig. 8). Although there is some overlap of the sizes, in general, the typical *N. chamberlini* is distinctly larger than the typical *N. pearcei.*

Description.—*Male:* Total length 6.9 (3.8–9.1). Carapace 3.4 (1.9–4.5) length, 2.7 (1.6–3.7) width. Abdomen 3.4 (1.8–4.9) length, 2.1 (1.1–3.0) width. Cymbium 1.08 (0.85–1.26)



Figures 6–8.—*Neoanagraphis pearcei* Gertsch. 6. Male left palp, ventral view; 7. Same, retrolateral view (scale = 0.25 mm); 8. Epigynum, ventral view, hairs removed from ventral surface (scale = 0.1 mm). "e" = dorsally-directed embolus, additional arrows point to dorsal process of retrolateral tibial apophysis.

length. Additional spination differing from that presented for genus: femora: I r 0-1-1-1, II r 0-1-1 or 0-1-1-1, III p 0-1-1-0-1 or 1-1-1-1, IV p 0-1-1-0-1, r 0-1-1 or 0-1-1-0-1; tibiae: I p (variable with 2 or 3 spines), v 2-2-(2) (apicals weak), II p 1-1-1, r (variable with 0 to 2 spines), v 2-2-(2) (apicals weak), III r 0-1-1 or 1-0-1, IV r 1-0-1 or 1-1-0-1; metatarsi: II p (variable with 0 to 2 spines), d 1-1-0.

Female: Total length 7.7 (5.5–9.7). Carapace 3.6 (2.9–4.5) length, 2.8 (2.2–3.6) width. Abdomen 4.1 (2.3–5.7) length, 2.5 (1.3–3.8) width. Epigynal plate: 0.20 (0.14–0.24) for both length and width. Epigynal plate bordered anteriolaterally by conspicuous, posteriorly-directed spurs varying in shape from sharp spike to equilateral triangle. At posterior edge, plate varying from smoothly rounded U-shape (rare) to sharp, narrow V-shape (common); if extends posteriorly, plate more likely to be V-shaped. Spination as in male except for: femora: I d 1-1-0-1, II d 1-1-0-1, III r 0-1-1; tibiae: I p (variable with 0 to 2 spines).

Distribution.—From the mountains around the Central Valley through the southeastern deserts in California, into southern Nevada, the southern half of Arizona, New Mexico and the western edge of Texas (Fig. 10). Also in the state of Sonora in Mexico.

Material examined.—Holotype male, 112♂21♀, 46 immatures. **MEXICO:** *Sonora:* 5 mi. N. Hermosillo, near sea level, in unidentified rodent burrow, 16 April 1952, 1♀, R. Ryckman & K. Arakawa (AMNH), S. end Sonoita River, 26 November 1959, 1♂, V. Roth (AMNH). **UNITED STATES: Arizona:** *Cochise County:* Portal, 4800 feet, 8 August 1965, 1 imm., W. Gertsch (AMNH); 13.5 mi S. Apache, 4330 feet, in kangaroo rat mound, 8 September 1968, 1♂, 1 imm., E. Moore & T. Walker (VDR), 5 mi. N. Portal, 4770 feet, 19 April 1977, 1♀, R. Chew (VDR); Chiricahua Mountains, Southwest Research Station, 5400 feet, 16 September 1985, 1♂, V. Roth (CAS). *Graham County:* Calva, 3500 feet, 3 November 1955, 1♀, V. Roth (AMNH). *Pima County:* Organ Pipe Cactus National Monument, 1700 feet, on restroom floor, 18 November 1989, 1♂, W. Icenogle & T. Prentice (WRI); Tuc-

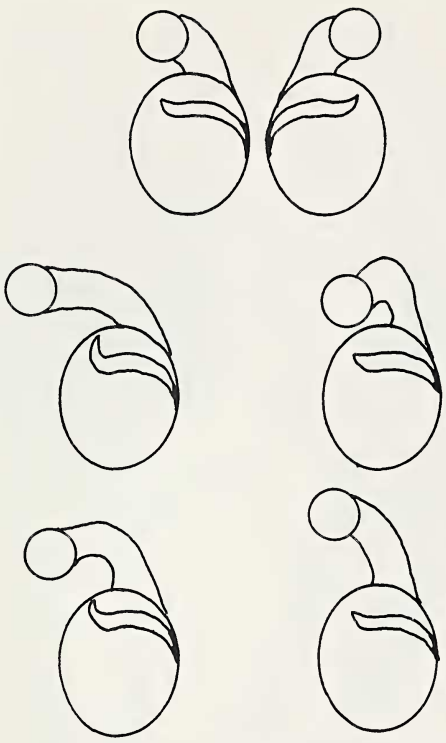


Figure 9.—Schematic drawings of the dorsal view of female *Neoanagraphis* genitalia. The top figure is the most common configuration of paired structures for both species. The remaining four figures show the variation among individuals with only one side drawn.

son, 2400 feet, 8 October 1953, 1♂, M. Cazier (AMNH), no date, 1♂, O. Bryant (AMNH). *Yavapai County:* Congress, 3000 feet, 8 August 1948, 1 imm., C. & P. Laurie (AMNH). *Yuma County:* Cabeza Prieta National Wildlife Refuge, Tule Well, 600 feet, pitfall traps, 9 November 1996, 3♂, V. Roth & D. Richman (NMSU); **California:** *Fresno County:* N. Kettleman Hills, under boards, 8 December 1993, 1♀, W.H. Tyson (CDFA). *Imperial County:* 1 mi W Harper's Well, San Felipe Creek, −100 feet, in dunes, probably 11 July 1968 (not 7 November), 1 imm., M.E. Irwin & P.A. Rauch (UCR); 3 mi NW Glamis, sand dunes, 4 March 1972, 1♀, A.R. Hardy (UCR). *Inyo County:* China Lake Naval Air Weapons Station, near S. Coso Village, 5800 feet, 27 May–8 June 1996, 1♀; 22 June–10 August 1996, 1 penult. ♀; in wash, 9 June–10 August 1996, 3 imm.; near Birchum Springs, 10 August–14 September 1996, 1♂; 22 June–10 August 1996, 1♂; White Hills, in pitfall trap under Joshua trees, 10 August–14 September 1996, 3♂; 4 mi N Flight Line & GI roads, 14 September 1996–15 February 1997, 1♀, G. Pratt & C. Pierce (UCR). *Kern County:* E. Randsburg, 12 April 1968, 1 imm.,

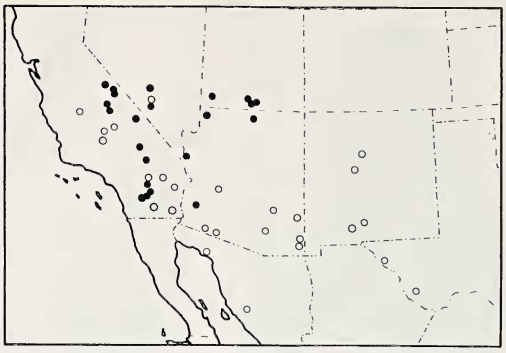


Figure 10.—Southwestern United States and northern Mexico. Distribution of *Neoanagraphis chamberlini* (○) and *N. pearcei* (●).

J. Cherry (UCR), Edwards Air Force Base, Leuman Ridge, 23 November 1997, in pitfall under *Larrea tridentata,* 1♂, C. & M. Breidenbaugh (UCR). *Riverside County:* Rice Dunes, 25 February 1978, 1♀, F. Andrews & A. Hardy (CDFA). *San Bernardino County:* Cadiz Dunes, 25 April 1978, 1 imm., A. Hardy & F. Andrews (CDFA); Joshua Tree National Monument, Cow Camp, 5800 feet, in pitfall traps, 24 September 1994, 5♂, W. Sakai (UCR); Twentynine Palms, October 1944, 1♂, J. Branch (AMNH). **Nevada:** *Nye County:* Nevada Test Site (see below), 61♂5♀, 35 imm., D. Allred (AMNH). **New Mexico:** *Bernalillo County:* Albuquerque, Indian Petroglyph State Park, 5000 feet, 7 June 1995, 1♂, summer 1996, 1♂, D. Lightfoot (UCR). *Doña Ana County:* Jornada Experimental Range, 4300 feet, in lowland grass pasture, 21 October 1999, 1♂, D. Richman (NMSU). *Otero County:* White Sands, August 1934, 1♂ (holotype), S. Mulaik (AMNH). *Socorro County:* 20 mi N Socorro, 4500–6500 feet, 1989–1992, 26♂7♀, 1 imm., S. Brantley (UCR). **Texas:** *Hudspeth County:* 8 mi. W. Sierra Blanca, 5 September 1946, 1♂ (AMNH). *Presidio County:* in nest of *Cratageomys castanops,* August 1948, 1♀, G. Menzies (AMNH).

Neoanagraphis pearcei Gertsch 1941
Figs. 6–8, 10

Neoanagraphis pearcei Gertsch, 1941: 19–20, fig. 46. Male holotype - Yermo, San Bernardino Co., California, 28 October 1939, in AMNH, examined.

Diagnosis.—See *N. chamberlini.*

Description.—*Male:* Total length 4.6 (3.2–6.8). Carapace 2.3 (1.7–3.0) length, 1.8 (1.3–2.6) width. Abdomen 2.4 (1.5–3.8) length, 1.4 (0.8–2.2) width. Cymbium 0.80 (0.49–1.02) length. Additional spination from that presented for genus: femora: I r 1-1-0-1, II r 1-

1-1 or 1-1-0-1, III r 0-1-1 or 1-1-1, IV r 0-1-1; tibiae: I p 1-1-0-1 or 1-1-1-1, r 1-1-1, v 2-2-2-(2) (apicals weak), II p 1-1-1-1, r 1-1-1, v 2-2-2-(2) (apicals weak), III r 0-1-1 or 1-1-1, IV r 1-1-1; metatarsi I p (variable with 0 to 2 spines), r 0-1-0 or none, II p 1-1-0, r 0-1-0, III d 0-1-0 or 1-1-0.

Female: Total length 6.0 (4.0–8.1). Carapace 2.8 (2.1–3.5) length, 2.2 (1.6–2.9) width. Abdomen 3.2 (1.8–4.8) length, 2.1 (1.2–2.9) width. Epigynal plate 0.15 (0.10–0.18) length, 0.24 (0.18–0.31) width. Epigynal plate bordered anteriolaterally by minute posteriorly-directed spurs; at posterior edge, plate typically rounded, U-shaped, extending only about to midpoint of underlying spermathecae (which can be seen through integument). Spination as in male except for: femora: I r (variable with 0 to 2 spines); tibiae: I p (variable with 0 to 3 spines), r none, II p 1-1-0-1, r none, IV r 0-1-1 or 1-1-1; metatarsi: II p none, r none, III d (variable from 1 to 3 spines).

Distribution.—Eastern Sierra Range south into the mountains surrounding the Coachella Valley in California, southern portions of Nevada and Utah, north and western Arizona (Fig. 10).

Material examined.—Holotype male, 86♂, 27♀, 25 imm. **UNITED STATES: Arizona:** *Mohave County:* 1 mi SE Bullhead City, 600 feet, pitfall trap, 22–26 December 1980, 1♂1♀, B. Phelps (CDFA); Virgin River, 3 mi N, 7 mi E Littlefield, in pitfall trap, March-October 1982, 1♀, D. Giuliani (CAS). *Yuma County:* near Sheep Tank Mine, 29 October 1958, 1♀, V. Roth (VDR). **California:** *Inyo County:* E. side Owens Lake, 17 September 1977, imm., F. Andrews & A. Hardy (CDFA); Eureka Valley, pitfall traps, November-December 1977, 2♂, February 1978, 1♀, April 1978, 1♀, D. Giulani, A.R. Hardy & F.G. Andrews (CDFA); N. Eureka Valley, Inyo Mountains, Willow Springs Canyon, 3000–3600 feet, 29 September 1980–18 March 1981, 4♂; 6 mi E. Independence, 4600 feet, 6 December 1984–20 December 1986, 1♀; White Mountains, 5000 feet, 6 mi NE Big Pine, 25 April–22 July 1982, 1♀; 3 mi SW Big Pine, in pitfall, 6 October 1985–13 May 1986, 1♂; 1 mi W Big Pine, 4100 feet, October 1985–May 1986, 2♂, D. Giuliani (CAS); Death Valley National Monument, Scotty's Ranch at Travertine Springs, 2500 feet, 13 January 1981, 1♀, V. Roth (CAS); China Lake, Mt. Springs Canyon, 4500 feet, crawling on sand dune at night, 10 October 1997, 1♂, G. Pratt (UCR). *Mono County:* 9 mi N Bishop, Fish Slough, 4200 feet, sand dunes, 9 June–9 August 1987, 1♀, D. Giuliani (CAS). *Riverside County:* Joshua Tree National Monument, pitfall traps, Fried Liver Wash, 30 October 1965, 1♂; Quail Guzzler, 29–30 October 1965, 2♂; Pinyon Wells, 11 November 1965, 1♂; 0.7 mi S. Squaw Tank, no date, 1♂; Pleasant Valley, 2 December 1966, 1♂; 30 October 1968, 1♂, E.L. Sleeper, S.L. Jenkins (JLO); Boyd Desert Research Center, Coyote Creek, 3.5 mi S Palm Desert, pitfall trap, 10 May 1975, 1♀, W. Icenogle (WRI); Santa Rosa Mountains, Deep Canyon, 0.5 mi S junction Hwy 74 & Pinyon Crest turnoff, 3600 feet, in *Aphonopelma* burrow, 22 July 1976, 1♂1♀ (collected as immatures, matured late August), W. Icenogle (WRI); Cactus City, 10 mi W Chiriaco Summit off I-10, 1300 feet, in pitfall trap in wash, 29 April 1999, 1♀, 18 December 1999, 1♂1♀, R. Vetter (UCR). *San Bernardino County:* Yermo, 28 October 1939, 1♂ (holotype), W.M. Pearce (AMNH); Fort Irwin, Avawatz Mountains, 6150 feet, 22 May–17 June 1996, 1♀, G. Pratt & C. Pierce (UCR), 4250 feet, 26 May 1997, 1 imm., G. Pratt, W. Savary & D. Ubick (CAS); Pisgah Lava Flats, 24 May 1960, 1♂, B. Banta (CAS); Pisgah Crater, 11 February 1961, 2♀; 11 March 1961, 1♀; 12 April 1961, 1♀; 11 November 1961, 2♂1♀; 19 November 1962, 1♂, Norris & Heath (AMNH). **Nevada:** *Nye County:* Nevada Test Site (see below), 62♂7♀, 23 imm., Allred et al.(AMNH); Monitor Summit, 3 mi N, 17 E Tonopah, 6400 feet, March–October 1982, 1♂, D. Giuliani (CAS). **Utah:** *Washington County:* 10 mi N St. George, 21 July 1952, 1♀, M. Cazier, W. Gertsch, Schrammel (AMNH). Additional locales presented in Fig. 10 are listed in Allred & Gertsch (1976) and Allred & Kaston (1983) but material was not examined. **Utah:** *Kane County:* Nipple Bench, Smoky Mountain, Ahlstrom Point.

NEVADA TEST SITE

In 1960–1961 a comprehensive faunal survey was undertaken (Allred et al. 1963a) to inventory the animal diversity at the Nevada Test Site where atomic bombs were detonated in the 1940's. Twenty different collection techniques were employed; the fauna collected consisted of invertebrates (insects, arachnids, chilopods, millipedes) and vertebrates (reptiles, birds, rodents, carnivores, rabbits, artiodactyls); sampling occurred year-round. The survey encompassed about 3367 km^2 with exhaustive collection arrays differentiated by the dominant plant species. Inventory results are reported in Allred et al. (1963a) while the cryptic locale data (e.g., each spider label had Mercury, Nevada as the collection locale with a designation such as "4AA5C") was decoded by using the depository amendment (Allred et al. 1963b).

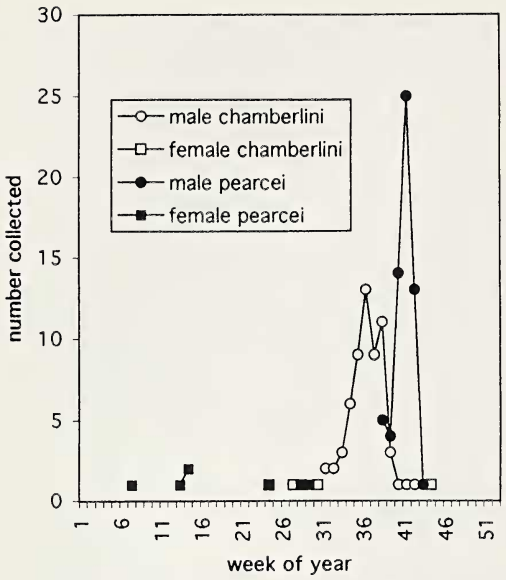


Figure 11.—Seasonal collection phenology of *Neoanagraphis chamberlini* (○) and *N. pearcei* (●) at the Nevada Test Site, Nye County, Nevada, 1960–1961.

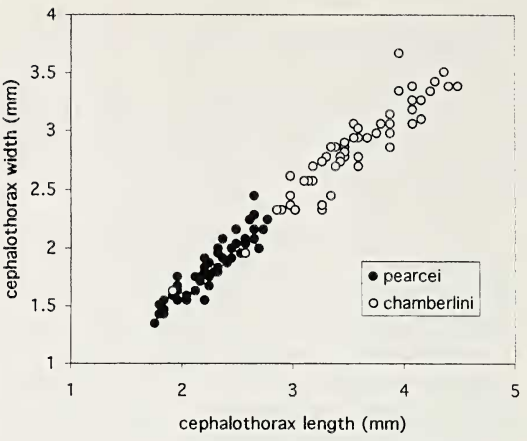


Figure 12.—Comparison of cephalothorax lengths and widths of mature male *Neoanagraphis chamberlini* (○) and *N. pearcei* (●) from the Nevada Test Site, Nye County, Nevada, 1960–1961. (n = 58 for each species).

In the course of this revision, 62% (123 of 200) of the mature males and 61% (193 of 319) of all spiders examined were collected by Allred et al. (1963a) at NTS. Both species of *Neoanagraphis* were collected at NTS; specimens deposited at AMNH were about equally divided between the two species. Almost all *Neoanagraphis* spiders were collected in pitfall traps which explains the preponderance of males, most probably as they wandered in search of females. This affords a rather rare opportunity to examine characteristics between the two almost sympatric populations to compare traits where environmental conditions would be fairly similar.

Despite the fact that both species of *Neoanagraphis* spiders were collected within the NTS, there are striking differences between them. The temporal collection profiles show little overlap in phenology. Mature males of *N. chamberlini* were collected most often from mid-August until late September, and mature males of *N. pearcei* were collected from mid-September to late October (Fig. 11). (Specimens collected outside of NTS corroborate this phenology.) Despite being congenerics, there was an almost dichotomous separation in size as measured by the cephalothorax length and width of mature males; only two very small *N. chamberlini* overlapped with the size range of *N. pearcei* (Fig. 12). (Specimens collected outside of NTS show similar patterns but with greater overlap (data not shown)). The two species also showed habitat differences in that *N. chamberlini* preferred the flat terrain of Yucca Flats which consisted of communities of *Coleogyne, Grayia-Lycium, Atriplex-Kochia* and thistle (i.e., tumbleweed, *Salsola kali*). In comparison, *N. pearcei* was found most often 15 km southward in the more montane sections of the NTS with a plant community strictly of creosote (*Larrea divaricata*) and *Franseria* sp.

Determination of immatures with spination.—Because mature specimens of the two *Neoanagraphis* species are readily differentiated by spination pattern and preferred distinctly different habitats at NTS, the NTS immatures were also examined to see if anterior tibia spination could be correlated with locale. Immature anterior ventral tibial spine pattern and cephalothorax length was recorded. Spination pattern was correlated to the coded locale data.

Immature spiders separated almost dichotomously into two groups with either 2 pairs or 3 pairs of anterior ventral tibial spines; there were a few immatures with 5 spines which were placed in the 3-pairs-of-spines group because spiders are more likely to add spines with age rather than lose them. (From

previous examination of mature specimens if there were supernumerary spines on *N. chamberlini* it usually was double the normal pattern, that is, 4 pairs of ventral tibial spines). When immature spination type was matched with locale data, the 2-pair-of-spines immatures (cephalothorax length: 0.93–3.67 mm) were found almost entirely in the flatland region (35 of 36) where *N. chamberlini* adults were most often found. The 3-pairs-of-spines immatures (cephalothorax length: 0.94–2.57 mm) were found almost exclusively in the mountain ranges (22 of 23) where adult *N. pearcei* was predominant.

With this evidence, it is reasonable to state that the spination aspect from the key above will successfully determine both species of *Neoanagraphis* spiders even as immatures. The generic characteristic of elongate tarsal claws III and IV is evident in the smallest spiders examined here. Therefore, even if one has disarticulated limbs and can verify a spiderling as *Neoanagraphis,* one can then identify it to species (unless additional species occur) by finding an anterior leg (which has a less elongate claw than the posterior legs) and examine spination pattern on the ventral tibial surface because it is the same for leg I and II.

Familial reassignment.—Specimens sent to AMNH were examined microscopically and with a scanning electron microscope. Dr. Norman Platnick has transferred the genus *Neoanagraphis* to the Liocranidae on the basis that the female has three cylindrical gland spigots on each posterior median spinneret and two on each posterior lateral spinneret (N.I. Platnick pers. comm.). Cylindrical (or tubuliform) glands, used in construction of eggsac silk, are lacking in the clubionids (Kovoor 1987). In addition, the male palpal structure of *Neoanagraphis* corresponds well with that of the liocranid genus *Agroeca* (N.I. Platnick pers. comm.) and other liocranids (J. Bosselaers pers. comm.).

Current keys.—The spider genus *Neoanagraphis* does not appear in any edition of Kaston's basic spider keys, *How to Know the Spiders* (Kaston 1953, 1972, 1978). In Roth (1993), under the Clubionidae, *N. pearcei* will properly key out to Group IV and then further to the *Neoanagraphis* couplet. In contrast, *N. chamberlini* does not key out correctly. At couplet 10, it gets shunted to Group III on the basis of its two pairs of ventral macrosetae. Continuing through the Group III key, it will terminate at the *Agroeca* couplet or not key out at all depending upon one's degree of differentiation.

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